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(54) Title: POLISHING COMPOSITION

(57) Abstract: A polishing composition of abrasive grains, a phosphorus-containing inorganic acid or salt thereof and another inorganic acid or salt thereof contained in an aqueous medium is used for the polishing of magnetic disk substrates or the like.

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DESCRIPTION

Polishing Composition

Cross Reference to Related Applications:

This application is an application filed under 35 U.S.C. § 111(a) claiming the benefit pursuant to 35 U.S.C. § 119 (e) (1) of the filing date of Provisional Application Serial No. 60/317, 962 filed on September 10, 2001 pursuant to 35 U.S.C. § 111(b).

Technical Filed:

The present invention relates to a polishing composition suited to the polishing of a magnetic disk substrate used in a storage device for a computer or the like, and more particularly to a composition for polishing a magnetic disk substrate that can provide a magnetic disk surface polished with high precision suitable for when a magnetic head flies over the disk surface while floating at a low level.

Background Art:

Among the external storage devices for a computer or word processor, the magnetic disk (memory hard disk) is widely used as a means of performing high-speed access. One typical example of this magnetic disk is a disk obtained by subjecting the surface of an Al-alloy substrate to electroless plating with NiP to form a substrate, polishing the surface of the substrate, and successively sputtering a Cr-alloy undercoat layer, a Co-alloy magnetic layer and a carbon protective layer on the substrate in that order.

If a protrusion of such height so as to exceed the floating level with the magnetic head remains on the magnetic disk surface, the magnetic head which flies at high speed while floating at a stipulated height above the disk surface may collide with the protrusion, thereby causing damage. In addition, when a protrusion or a scratch caused by polishing is present on

the magnetic disk substrate, the protrusion also appears on the Cr-alloy undercoat layer and the Co-alloy magnetic layer when such layers are overlaid, and a flaw caused by the scratch is produced, whereby the magnetic disk surface does not have a high-precision smooth surface. Accordingly, it is necessary to polish the substrate precisely to enhance the precision of the disk surface.

For the polishing of the magnetic disk substrate, many polishing compositions are proposed that can remove the protrusions completely or buff the protrusion down to a height as low as possible, without easily producing any scratches.

The JP-A-HEI 9-204657 discloses the use of a composition prepared by adding aluminum nitrate and an anti-gelling agent to colloidal silica. JP-A-HEI 9-204658 discloses the use of a composition prepared by adding aluminum nitrate to fumed silica. Each of the compositions disclosed in these publications comprises finely divided particles of silicon oxide with low hardness serving as the abrasive grains, so that good surface precision can be easily obtained although it is difficult to achieve a polishing speed suitable for actual production.

Furthermore, in JP-A-HEI 10-204416, the use of many kinds of oxidizing agents and the use of Fe salts are independently proposed to accelerate the polishing speed. However, the polishing speed thus obtained is still insufficient in light of actual production in practice.

A composition for polishing an aluminum magnetic disk substrate that permits high-density magnetic storage is required to provide a disk surface with high precision that enables a head to fly at a low level.

Accordingly, an object of the present invention is to provide a composition for polishing a magnetic disk substrate capable of realizing high-density magnetic storage, where such composition can give the magnetic disk substrate a low surface roughness with no protrusions or

scratches caused by polishing and can polish the magnetic disk substrate at a cost-effective speed.

Disclosure of the Invention:

The polishing composition according to the present invention comprises:

abrasive grains, a phosphorus-containing inorganic acid or salt thereof and another inorganic acid or salt thereof contained in an aqueous medium.

Furthermore, the abrasive grains are at least one selected from the group consisting of alumina, titania, silica and zirconia.

Moreover, the mean particle size of the abrasive grains is from 0.001 to 0.5 μm and the abrasive grains are colloidal particles.

In addition, the phosphorus-containing inorganic acid is phosphoric acid or phosphonic acid, the other inorganic acid is at least one acid selected from the group consisting of nitric acid, sulfuric acid, amidosulfuric acid and boric acid.

Furthermore, the oxidizing agent is at least one compound selected from the group consisting of the peroxides, perborates, persulfates or nitrates, the peroxide is hydrogen peroxide and the perborate is sodium perborate.

In addition, the pH of the polishing composition is 1 to 5.

Moreover, the abrasive grain content is in the range from 3 to 30% by mass, the content of the inorganic acid or salt thereof is in the range from 0.1 to 8% by mass and the oxidizing agent content is in the range from 0.2 to 5% by mass.

In addition, the polishing composition according to the present invention is a composition for polishing magnetic disk substrates.

The present invention also comprises a magnetic disk substrate polished by the aforementioned composition for polishing magnetic disk substrates.

As described above, the polishing composition according to the present invention comprises two or more specific organic acids or salts thereof, and thus the state of dispersion becomes good, and by taking a phosphorus-containing organic acid or salt thereof as a mandatory constituent, the effects of increasing the polishing rate and suppressing the occurrence of micro-scratches are boosted, so a magnetic disk substrate that has a high-precision disk surface is obtained.

Best Mode for Carrying out the Invention:

The inventors of the present invention have diligently investigated an abrasive that can provide a polished surface with high precision required for an aluminum magnetic disk for use with a low-flying magnetic head. As a result, the inventors have found a polishing composition that exhibits excellent properties in polishing an aluminum magnetic disk, leading to the present invention.

The polishing composition of the present invention is characterized in that abrasive grains, a phosphorus-containing inorganic acid or salt thereof and another inorganic acid or salt thereof are contained in an aqueous medium.

The abrasive grains contained as an abrasive for use in the polishing composition of the present invention are not particularly limited. For example, alumina, titania, silica, zirconia and the like can be employed, and the crystalline form thereof is not limited. For instance, alumina (i.e., aluminum oxide) has the α , γ , δ , η , θ , κ , χ and other crystalline forms; titania (i.e., titanium oxide) has the rutile, anatase, brookite and other crystalline forms; silica (i.e., silicon oxide) includes the colloidal silica, fumed silica, white carbon and other forms; and zirconia (i.e., zirconium

oxide) has the monoclinic, tetragonal and amorphous forms. Any of these can preferably be used. The abrasive grains in the form of colloidal particles preferably boost suppressing the occurrence of micro-scratches.

The aforementioned abrasive grains have a mean particle size normally in the range of 0.001 to 0.5 μm , preferably in the range of 0.001 to 0.2 μm , more preferably in the range of 0.02 to 0.2 μm , and most preferably in the range of 0.03 to 0.2 μm . In addition, abrasive grains in the form of colloidal particles are even more preferable. Here, the mean particle size is used is a value measured by a Microtrac UPA150 (made by Honeywell, Inc.) laser Doppler frequency analysis-type particle size distribution analyzer.

As the particle size of the abrasive grains increases, gelling and aggregation of fine particles are more easily suppressed, but the probability of the presence of coarse grains increases, thereby causing scratches to occur in the course of polishing. Conversely, as the particle size of the abrasive grains decreases, the aforementioned gelling and aggregation occur more easily and this also causes scratches to occur in the course of polishing.

When the abrasive grain concentration within the polishing composition of the present invention is less than 3% by mass (hereinafter indicated by simply "%" unless otherwise noted), the polishing speed is significantly decreased. As the abrasive grain concentration increases, the polishing speed increases, but when the abrasive grain concentration exceeds 30%, not only is no increase in polishing speed seen, but gelling takes place readily, particularly when the abrasive grains are in the form of colloidal particles. In view of cost efficiency, an upper limit for the concentration is 30% for practical use. Accordingly, the concentration of the abrasive grains in the polishing composition is preferably in the range of 3 to 30% and more preferably 5 to 15%.

In the polishing composition of the present invention, both a phosphorus-containing inorganic acid or salt thereof and another inorganic acid or salt thereof are used. The phosphorus-containing inorganic acid

must contain phosphorus as a constituent element of the compound, and is preferably phosphoric acid or phosphonic acid. The phosphorus-containing inorganic acid also comprises derivatives thereof. Two or more phosphorus-containing inorganic acids may also be used together.

The other inorganic acid used mixed with the phosphorus-containing inorganic acid may be hydrochloric acid, sulfuric acid, chromic acid, carbonic acid, amidosulfuric acid, boric acid or other acid, but nitric acid, sulfuric acid, amidosulfuric acid or boric acid is preferable. These acids also comprise derivatives thereof. The salts of the phosphorus-containing inorganic acid or salt thereof and the another inorganic acid or salt thereof used may be salts of Li, Be, Na, Mg, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Al, Zr, Nb, Mo, Pd, Ag, Hf, Ta, W or other metals. These salts may be obtained by dissociating an oxide or carbonate of the aforementioned metals, for example, in a phosphorus-containing inorganic acid or another inorganic acid.

In the polishing composition of the present invention, the total content of the phosphorus-containing inorganic acid or salt thereof and another inorganic acid or salt thereof may be in the range from 0.1 to 8%, preferably 0.2 to 6% and more preferably 0.4 to 4%. When content of inorganic acid or salt thereof is less than 0.1%, no effect of suppressing micro-scratches or increasing the polishing speed is seen. In excess of 8%, the drop in pH is significant, thus leading to great damage to the polishing material so this causes problems in handling. The proportion of mixing the phosphorus-containing inorganic acid or salt thereof and another inorganic acid or salt thereof is preferably: to 1 mole of the former is added a range of 0.1 to 5 moles of the latter.

If the latter is less than 0.1 moles, then the dispersibility in slurry deteriorates and the micro-scratches increase. If 5 moles is exceeded, the pH drops and the damage to the polishing material increases.

The polishing composition according to the present invention comprises two or more specific organic acids or salts thereof, but by taking a phosphorus-containing organic acid or salt thereof as a mandatory constituent, the effects of increasing the polishing rate and suppressing the occurrence of micro-scratches are boosted.

In the present invention, the mechanism behind the effect of using two or more specific organic acids or salts thereof is not certain, but one is presumed to be because the state of dispersion as a polishing composition becomes better.

The oxidizing agent contained in the polishing composition of the present invention is preferably at least one compound selected from the group consisting of the peroxides, perborates, persulfates or nitrates, where representative examples include: hydrogen peroxide as a peroxide, sodium perborate as a perborate, ammonium persulfate as a persulfate and ammonium nitrate as a nitrate. Note that if the aforementioned other inorganic acid or salt thereof has an oxidizing action, then it can also serve as the oxidizing agent, so it is possible to use that inorganic acid or salt thereof alone. For example, a nitrate may be used both as the salt of the other acid and as the oxidizing agent. Note that even in the case that the other inorganic acid or salt thereof has an oxidizing action, a different oxidizing agent may also be added.

Examples of the effects of the oxidizing agent include increasing the polishing rate and reducing the surface roughness. While the mechanisms of these effects are not clear, they are thought to be the effect as an etching agent on the NiP surface.

The content of the oxidizing agent (i.e., hydrogen peroxide) should be 0.2 to 5% or preferably 0.5 to 2%. If the oxidizing agent content is less than 0.2% then the effect of increasing the polishing rate and reducing the surface roughness is minuscule, but if 5% is exceeded then its effect reaches saturation.

The content of the other inorganic acid or salt thereof in the event that it is also used as the oxidizing agent becomes the content of both, namely the content as the other inorganic acid or salt thereof and the content as the oxidizing agent. Accordingly, the sum of the content of the phosphorus-containing inorganic acid or salt thereof and the other inorganic acid or salt thereof is preferably 0.3 to 13% or more preferably 0.7 to 8%.

Moreover, in the case that the aforementioned composition contains inorganic acids or salts thereof not also used as oxidizing agents, it is possible to include one or the other of the also used inorganic acid or salts thereof to the maximum limit, and then determine the upper limit for the content of the remaining oxidizing agent not also used. For example, in the case of phosphoric acid, a nitrate (a salt of another inorganic acid and also an oxidizing agent) and hydrogen peroxide, the content of the nitrate may be determined as all being the other inorganic acid, while the hydrogen peroxide may be taken as the oxidizing agent and its upper limit can be set to 5%. In addition, in the case that an inorganic acid or salt thereof that is not an oxidizing agent such as a nitrate for example is included, the nitrate is included as an oxidizing agent with 5% as the limit, and the amount of the remaining non-oxidizing inorganic acid or salt thereof can be determined. In either case, the sum of the content of the phosphorus-containing inorganic acid or salt thereof, the other inorganic acid or salt thereof and the oxidizing agent is preferably 0.3 to 13% and more preferably 0.7 to 8%.

In the polishing composition of the present invention, the pH range is preferably 1 to 5, more preferably 2 to 4 and even more preferably 2 to 3. Making the liquid acidic can accelerate the oxidation of Ni and increase the polishing rate, but if the pH is too low, corrosion of equipment and other problems occur, so the pH is most preferably 2 to 3. Adjustment of the pH can be performed using sodium perborate.

Note that the concentrations of the various aforementioned components are the concentrations at the time of polishing the magnetic

disk substrate. In the case that a polishing composition is transported after being produced, it is advantageous to prepare a composition with a concentration higher than that described above and dilute it to the aforementioned concentrations before use.

The magnetic disk substrate polishing composition according to the present invention may further comprise surfactants and preservatives in addition to the aforementioned components. However, close attention must be paid with respect to their type and content so that gelling does not occur.

An anti-gelling agent may be added to the polishing composition in order to suppress gelling. As the anti-gelling agent that may be used, at least one compound selected from the group consisting of a phosphonic acid compound, phenanthroline and aluminum acetylacetonate is preferably employed. Specific examples of the phosphonic acid compound include phosphoric acid, 1-hydroxyethane-1,1-diphosphonic acid ($C_2H_6O_7P_2$) and aminotrimethylenephosphonic acid ($C_2H_{12}O_9P_3N$). 1,10-phenanthroline monohydrate ($C_{12}H_8N_2 \cdot H_2O$) and an aluminum complex salt of acetylacetone ($Al_2[CH(COCH_3)_3]_3$) are respectively given as examples of the phenanthroline compound and the aluminum acetylacetonate. It is preferable that the anti-gelling agent be added to the polishing composition in an amount of 2% or less.

The polishing composition of the present invention can be prepared by suspending the abrasive grains in water and adding the phosphorus-containing inorganic acid or salt thereof, nitrate-containing inorganic acid or salt thereof and hydrogen peroxide to the suspension in a manner similar to that used in the preparation of conventional polishing compositions. All the components may be mixed and diluted for use. Alternatively, there is a method of preliminarily dividing the components into two groups, for example, one including water, abrasive grains and nitric acid, and the other including water, phosphoric acid and hydrogen peroxide,

and thereafter mixing the two groups together.

The polishing composition of the present invention is advantageously applicable to a substrate of a magnetic disk with a high storage density (generally, with a storage density of 3 Gbits/inch² or more), as represented by a magnetic disk for a magnetic head utilizing a magnetoresistance (MR) effect. Application to a magnetic disk with a lower storage density is also effective from the standpoint of improving reliability.

The magnetic hard disk substrates to which the polishing composition of the present invention is applicable are not particularly limited, but when the polishing composition of the present invention is applied to an aluminum substrate (including an aluminum alloy substrate), and particularly an aluminum substrate that is plated with NiP for example by electroless plating, a high-quality polished surface can be advantageously obtained from an industrial standpoint.

The polishing method typically comprises the steps of causing a polishing pad commonly used for a slurry-like abrasive to press against the magnetic disk substrate, and rotating the pad or the substrate while supplying the slurry to a gap between the pad and the substrate.

Magnetic disks made from substrates polished using the polishing composition of the present invention exhibit an extremely low frequency of occurrence of fine defects such as micro-pits and micro-scratches, and the surface of the magnetic disk has excellent surface smoothness, indicated by a surface roughness (Ra) of roughly 2 to 3 μm .

Here follows a detailed description of the present invention made with reference to examples, but the present invention is in no way limited to these examples.

Working Examples 1 to 15

Table 1 below shows the kinds of abrasives and the properties thereof used in the respective Working Examples and Comparative Examples.

Table 1

| Abrasive grain (Name used in Table 2) | Trade name | Mean particle size (μm) |
|---------------------------------------|-------------|--------------------------------------|
| Silicon oxide [1] (Silica [1]) | Syton HT-50 | 0.05 |
| Silicon oxide [2] (Silica [2]) | E-150J | 0.1 |
| Silicon oxide [3] (Silica [3]) | Aerosil 50 | 0.1 |
| Silicon oxide [4] (Silica [4]) | Snowtex 30 | 0.01 |
| Titanium oxide [1] (Titania [1]) | F-2 | 0.3 |
| Titanium oxide [2] (Titania [2]) | F-4 | 0.2 |
| Alumina | | 0.2 |
| Zirconia | | 0.2 |

Water, inorganic acid 1, inorganic acid 2 and an oxidizing agent were added to colloidal silica (Syton HT-50F) made by DuPont in the proportions indicated in Table 2 to prepare a variety of aqueous polishing compositions. Polishing was performed with a polishing machine under the polishing conditions given below. The results are shown in Table 2.

The mean particle size was measured with a Microtrac UPA150 (made by Honeywell, Inc.) laser Doppler frequency analysis-type particle size distribution analyzer. The measured values of the grain size are shown in Table 1. The pH of the composition was measured using a Horiba, Ltd. D-13 hydrogen ion concentration meter with glass electrodes.

Working Examples 16 and 17

A mixture of white carbon (E-150J) made by Nippon Silica Industrial Co., Ltd. and fumed silica (Aerosil 50) made by Nippon Aerosil Co., Ltd. was ground in a stirred mill and coarse particles were removed by classification, thereby obtaining silicon oxide with a mean particle size of 0.1 μm . Next, water, inorganic acid 1, inorganic acid 2 and an oxidizing agent were added in the proportions indicated in Table 2 to prepare a variety of aqueous polishing compositions. Polishing was performed with a polishing machine under the polishing conditions given below. The results are shown in Table 2.

Working Examples 18 to 20

Titanium oxide (Supertitania F-4) made by SHOWA TITANIUM CO., LTD., alumina and zirconia were ground in a stirred mill and coarse particles were removed by classification, thereby obtaining titanium oxide, alumina and zirconia with a mean particle size of 0.2 μm . Next, water, inorganic acid 1, inorganic acid 2 and an oxidizing agent were added in the proportions indicated in Table 2 to prepare a variety of aqueous polishing compositions. Polishing was performed with a polishing machine under the polishing conditions given below. The results are shown in Table 2.

Working Example 21

To colloidal silica (Snowtex 30) made by Nissan Chemical Industries, Ltd., water, inorganic acid 1, inorganic acid 2 and an oxidizing agent were added in the proportions indicated in Table 2 to prepare a variety of aqueous polishing compositions. Polishing was performed with a polishing machine under the polishing conditions given below. The results are shown in Table 2.

(Polishing conditions)

As a substrate, a 3.5-inch aluminum disk plated with NiP by electroless plating was employed.

(Polishing machine and polishing conditions)

Polishing machine 4-way double-sided polishing machine
Polishing pad Suede type (Polytex DG, made by Rodel, Inc.)
Lower surface plate speed 60 rpm
Slurry feed rate 50 ml/min
Polishing time 5 min
Working pressure 50 g/cm²

(Evaluation of polishing properties)

Polishing rate Calculated from the decrease in weight of the
aluminum disk after polishing
Surface roughness Measured using Talystep and Talydata 2000 (made by
Rank Taylor Hobson Co.)

The depth of polishing scratches was found using morphology analysis with a Tencor P-12 stylus-type surface analyzer in 3D mode.

Table 2 shows the results of evaluation of the polishing properties. The symbol A in the "Scratches" column in Table 2 indicates a polishing scratch depth of 2 nm or less. The symbol B in the "Scratches" column indicates a polishing scratch depth of 2-10 nm. No polishing scratch depths greater than 10 nm were found in either the Working Examples or Comparative Examples.

Comparative Examples 1 to 7

Water, aluminum nitrate, etc., and hydrogen peroxide were added to colloidal silica (Syton HT-50F) made by DuPont in the proportions indicated in Table 3 to prepare aqueous polishing compositions. Polishing was performed in the same manner as in the Working Examples. The results are shown in Table 3.

Comparative Example 8

Titanium oxide (Supertitania F-2) made by SHOWA TITANIUM CO., LTD.. was ground in a stirred mill and coarse particles were removed by classification, thereby obtaining titanium oxide with a mean particle size of 0.3 μm . Next, water and aluminum nitrate were added in the proportions indicated in Table 3 to prepare an aqueous polishing composition. Polishing was performed in the same manner as in the Working Examples. The results are shown in Table 3.

Comparative Example 9

Titanium oxide (Supertitania F-4) made by SHOWA TITANIUM CO., LTD.. was ground in a stirred mill and coarse particles were removed by classification, thereby obtaining titanium oxide with a mean particle size of 0.2 μm . Next, water and aluminum nitrate were added in the proportions indicated in Table 3 to prepare an aqueous polishing composition. Polishing was performed in the same manner as in the Working Examples. The results are shown in Table 3.

Table 2

| Working Example | Abrasive grains | | Inorganic acid | | | | Oxidizing agent | | pH | Polishing rate (μm/min) | Surface roughness Ra (nm) | Scratches | Pits |
|-----------------|-----------------|---------------------|-----------------|---------------------|--------------------|---------------------|-------------------------------|---------------------|-----|-------------------------|---------------------------|-----------|------|
| | Type | Content (% by mass) | 1 | | 2 | | Type | Content (% by mass) | | | | | |
| | | | Type | Content (% by mass) | Type | Content (% by mass) | | | | | | | |
| 1 | Silica [1] | 5 | Phosphoric acid | 1.5 | Nitric acid | 0.4 | H ₂ O ₂ | 0.5 | 1.3 | 0.18 | 0.2 | A | A |
| 2 | " | 10 | " | 1.5 | " | 0.4 | " | 0.5 | 1.4 | 0.21 | 0.2 | A | A |
| 3 | " | 15 | " | 1.5 | " | 0.4 | " | 0.5 | 1.6 | 0.22 | 0.2 | A | A |
| 4 | " | 10 | " | 0.5 | " | 0.4 | " | 0.5 | 1.6 | 0.19 | 0.2 | A | A |
| 5 | " | 10 | " | 3.0 | " | 0.4 | " | 0.5 | 1.2 | 0.22 | 0.2 | A | A |
| 6 | " | 10 | " | 1.5 | " | 0.2 | " | 0.5 | 1.6 | 0.19 | 0.2 | A | A |
| 7 | " | 10 | " | 1.5 | " | 0.6 | " | 0.5 | 1.2 | 0.22 | 0.2 | A | A |
| 8 | " | 10 | " | 3.0 | " | 0.4 | " | 0.3 | 1.4 | 0.19 | 0.2 | A | A |
| 9 | " | 10 | " | 3.0 | " | 0.4 | " | 2.0 | 1.4 | 0.22 | 0.2 | A | A |
| 10 | " | 10 | " | 1.5 | Amidosulfuric acid | 0.4 | " | 0.5 | 1.6 | 0.20 | 0.2 | A | A |
| 11 | " | 10 | " | 1.5 | Sulfuric acid | 0.4 | " | 0.5 | 1.4 | 0.20 | 0.2 | A | A |
| 12 | " | 10 | " | 1.5 | Boric acid | 0.4 | " | 0.5 | 1.5 | 0.20 | 0.2 | A | A |
| 13 | " | 10 | " | 1.5 | Nitric acid | 0.4 | NaBO ₃ | 1.5 | 1.7 | 0.21 | 0.2 | A | A |
| 14 | " | 10 | " | 1.5 | " | 0.4 | Ammonium persulfate | 2.0 | 1.2 | 0.20 | 0.2 | A | A |
| 15 | " | 10 | Phosphonic acid | 1.5 | " | 0.4 | H ₂ O ₂ | 0.5 | 1.4 | 0.21 | 0.2 | A | A |
| 16 | Silica [2] | 10 | Phosphoric acid | 1.5 | " | 0.4 | " | 0.5 | 1.4 | 0.20 | 0.2 | A | A |
| 17 | Silica [3] | 10 | " | 1.5 | " | 0.4 | " | 0.5 | 1.4 | 0.20 | 0.2 | A | A |
| 18 | Titania [2] | 6 | " | 1.5 | " | 0.4 | " | 0.5 | 1.4 | 0.21 | 0.3 | A | A |
| 19 | Alumina | 15 | " | 1.5 | " | 0.4 | " | 0.5 | 1.4 | 0.21 | 0.3 | A | A |
| 20 | Zirconia | 15 | " | 1.5 | " | 0.4 | " | 0.5 | 1.4 | 0.21 | 0.3 | A | A |
| 21 | Silica [4] | 10 | " | 1.5 | " | 0.4 | " | 0.5 | 1.4 | 0.14 | 0.1 | A | A |

Table 3

| Compara tive Example | Abrasive grains | | Inorganic acid | | | | Oxidizing agent | | pH | Polishing rate ($\mu\text{m}/\text{min}$) | Surface roughne ss Ra (nm) | Scratch es | Pits |
|----------------------------|-----------------|-------------------------------|-----------------------|---------------------------|------------------------|---------------------------|-------------------------------|---------------------------|-----|---|--|---------------|------|
| | Type | Conte nt (% by mass) | 1 | | 2 | | Type | Content (% by mass) | | | | | |
| | | | Type | Content (% by mass) | Type | Content (% by mass) | | | | | | | |
| 1 | Silica [1] | 10 | Aluminum nitrate | 5.0 | — | — | H ₂ O ₂ | 1.0 | 2.0 | 0.08 | 0.4 | B | A |
| 2 | " | 10 | — | — | — | — | " | 1.0 | 2.0 | 0.09 | 0.2 | A | A |
| 3 | " | 10 | Phosphoric acid | 3.0 | — | — | " | 1.0 | 1.5 | 0.11 | 0.2 | A | A |
| 4 | " | 10 | Phosphonic acid | 3.0 | — | — | " | 1.0 | 1.5 | 0.11 | 0.2 | A | A |
| 5 | " | 10 | Nitric acid | 0.4 | — | — | " | 1.0 | 1.5 | 0.11 | 0.2 | A | A |
| 6 | " | 10 | Amidosulfuric acid | 1.0 | — | — | " | 1.0 | 2.0 | 0.11 | 0.2 | A | A |
| 7 | " | 10 | Sulfuric acid | 0.4 | Amidosulfuri c acid | 0.4 | " | 1.0 | 1.3 | 0.11 | 0.2 | A | A |
| 8 | Titania [1] | 6 | Aluminum nitrate | 5.0 | — | — | — | — | 3.0 | 0.21 | 0.4 | B | B |
| 9 | Titania [2] | 6 | Aluminum nitrate | 5.0 | — | — | — | — | 3.0 | 0.21 | 0.3 | B | B |

Industrial Applicability:

When a disk is polished using the polishing composition according to the present invention, the disk can be quickly polished so that the surface roughness becomes extremely low. A magnetic disk made of the polished disk is useful as a low-flying head type hard disk capable of achieving high-density storage.

A magnetic disk thus polished is very useful particularly in high-density storage media (having a storage density of 3 Gbits/inch² or greater) represented by media that uses MR heads which utilize the magnetoresistance (MR) effect in magnetic disks, and is also useful from the standpoint of giving media with lower storage densities high reliability.

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CLAIMS

1. A polishing composition comprising abrasive grains, a phosphorus-containing inorganic acid or salt thereof and another inorganic acid or salt thereof contained in an aqueous medium.

2. The polishing composition according to claim 1, wherein the abrasive grains are at least one selected from the group consisting of alumina, titania, silica and zirconia.

3. The polishing composition according to claim 1 or 2, wherein the mean particle size of the abrasive grains is from 0.001 to 0.5 μm .

4. The polishing composition according to any of claims 1 through 3, wherein the abrasive grains are colloidal particles.

5. The polishing composition according to any of claims 1 through 4, wherein the phosphorus-containing inorganic acid is phosphoric acid or phosphonic acid.

6. The polishing composition according to any of claims 1 through 5, wherein the other inorganic acid or salt thereof is at least one acid selected from the group consisting of nitric acid, sulfuric acid, amidosulfuric acid and boric acid.

7. The polishing composition according to any of claims 1 through 6, wherein the oxidizing agent is at least one compound selected from the group consisting of the peroxides, perborates, persulfates or nitrates.

8. The polishing composition according to claim 7, wherein the peroxide is hydrogen peroxide.

9. The polishing composition according to claim 7, wherein the perborate is sodium perborate.

10. The polishing composition according to any of claims 1 through 9, wherein the pH is 1 to 5.

11. The polishing composition according to any of claims 1 through 10, wherein the abrasive grain content is in the range from 3 to 30% by mass,

the content of the inorganic acid or salt thereof is in the range from 0.1 to 8% by mass and the oxidizing agent content is in the range from 0.2 to 5% by mass.

12. The polishing composition according to any of claims 1 through 11, wherein the polishing composition is a composition for polishing magnetic disk substrates.

13. A magnetic disk substrate polished by the composition for polishing magnetic disk substrates according to claim 12.

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A. CLASSIFICATION OF SUBJECT MATTER

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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| X | WO 01 12740 A (CABOT MICROELECTRONICS CORP) 22 February 2001 (2001-02-22) page 3, line 20 -page 5, line 14 ----- | 1-13 |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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(54) Title: POLISHING COMPOSITION

(57) Abstract: A polishing composition of abrasive grains, a phosphorus-containing inorganic acid or salt thereof and another inorganic acid or salt thereof contained in an aqueous medium is used for the polishing of magnetic disk substrates or the like.

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